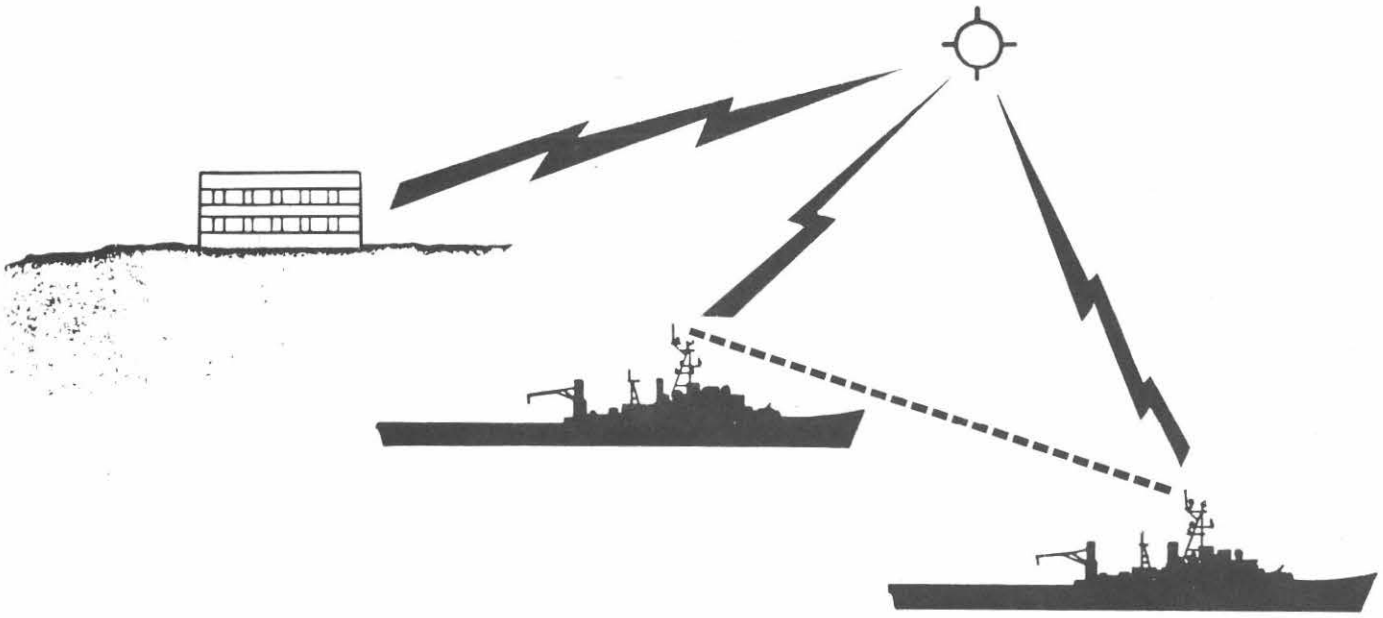
NAVY SHIPBOARD
REMOTE MEDICAL DIAGNOSIS SYSTEM



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ABSTRACT

Navy Shipboard Remote Medical Diagnosis.

Naval medical corpsmen will be used more extensively to provide total shipboard health-care. In order to determine medical diagnosis requirements and health-care needs for shipboard personnel, illnesses and accidents onboard all U.S. Naval ships were studied. This data was analyzed for frequencies of occurrences and variances among different types of ships and geographical areas to determine if independent duty corpsmen, aided with the capability of obtaining remote physician support, can effectively satisfy the medical needs of shipboard personnel during peacetime conditions. Methods of obtaining medical data remotely, both with present means of radio communications and potential methods utilizing satellites have been examined.

GLOSSARY OF SHIP TYPES

AD.....destroyer tender
AE.....ammunition ship
AF.....store ship
AFS.....combat store ship
AO.....oiler
AOE.....fast combat support ship
AOR.....replenishment oiler
AR.....repair ship
CG.....guided missile cruiser
CGN.....nuclear powered guided missile cruiser
CLG.....guided missile light cruiser
CVA.....attack aircraft carrier
CVAN.....nuclear powered attack aircraft carrier
CVS.....anti-submarine warfare aircraft carrier
DD.....destroyer
DDG.....guided missile destroyer
DE.....escort ship
DEG.....guided missile escort ship
DLG.....guided missile frigate
DLGN.....nuclear powered guided missile frigate
LCC.....amphibious command ship
LKA.....amphibious cargo ship
LPA.....amphibious transport
LPD.....amphibious transport dock
LPH.....amphibious assault ship
LSD.....dock landing ship
LST.....tank landing ship
SS.....attack submarine
SSBN.....nuclear powered ballistic missile submarine
SSN.....nuclear powered attack submarine

1. INTRODUCTION

The Navy, as well as the other military services, is presently experiencing a shortage of physicians. It is foreseen that this shortage will get worse in the future due to the ending of the doctor draft and recent salary increases for interns and residents in civilian hospitals. Because of this shortage and its impact on the delivery of health-care services at Naval Hospitals, many of the Navy physicians will necessarily be transferred from shipboard duty to hospitals. As a result, there will be more extensive use of Navy corpsmen, trained as physicians' assistants, to provide total shipboard health-care similar to the existing practice of independent duty corpsmen aboard small ships.

The ability to properly diagnose and determine appropriate treatment for illnesses and injuries is a critical part of any medical program. Many of the medical cases aboard ship are presently being diagnosed by corpsmen and given minor or emergency treatment without requiring the services of a physician. However, there are cases in which a corpsman (or even a physician) may be uncertain of a medical diagnosis, or a patient's condition may necessitate a decision of whether or not to air-evacuate the patient. It would then be desirable for the corpsman to have a direct communication link with a physician (located onboard another ship or ashore) to provide a remote diagnosis.

In order to facilitate a real-time medical diagnostic capability, the system must be able to transmit medical clinical data, and records possibly including ECG's, EEG's, and accompying voice transmissions. It may also be desirable to have a capability to transmit imagery or video, and provide a computer interface for record retrieval and storage.

The Naval Electronics Laboratory Center, San Diego, undertook a study to determine the needs and requirements for a Remote Medical Diagnosis System (RMDS); the following major tasks were delineated for investigation.

- Determine the medical needs and requirements for remote diagnosis aboard ships and submarines.
- Determine the present medical and diagnostic capabilities for various classes of ships.
- Determine a ship's population profile.
- Determine the communication requirements and evaluate alternative feasible systems.
- Complete feasibility and risk analysis for alternative systems.
- Perform operational tests.

To date, the major efforts on the RMDS study have centered around the first four tasks above. This paper presents some of the results from this study. The present system and the capabilities of shipboard health care are discussed in section 2; analyses of shipboard medical visits, and the medical data and instrumentation required for diagnoses are given in section 3; and the requirements for a remote diagnostic system (communication methods and hardware), and possible alternative systems are discussed in section 4.

2. PRESENT SHIPBOARD HEALTH CARE DELIVERY

Present medical and diagnostic capabilities for various classes of ships were determined by first examining available documents which inventory the medical complements and instrumentation aboard ships by specific class, and then by shipboard visits to augment these lists. From the compiled lists of medical instrumentation and complements for a class of ships, it is then possible to determine their diagnostic capabilities and compare the required

medical data and instrumentation for similar diagnoses.

2.1 PRESENT METHODS OF REMOTE DIAGNOSIS. When a corpsman or physician is not sure of a medical diagnosis for a patient, or he needs an outside decision regarding whether or not to air-evacuate the patient, he uses the ship's radio communication system to discuss the problem with a physician at another site (either onboard another ship or at a shore station).

Whenever it is necessary to communicate, the medical staff member notifies the ship's communication personnel that he wishes to send the message. If the message requires anything above a "routine" precedence classification (see section 4), he must get the approval of the ship's commanding officer or designated officer with approval authority. A "routine" message is sent via teletype (TTY) using available communication modes to the nearest available medical facility, also advising their chain of command, requesting medical advice. Due to present communication overloads, a response to this message may take as long as 3 or 4 days. In most medical cases this delay is unacceptable.

If it is an emergency, the commanding officer may grant the use of a higher precedence classification, or the use of a voice communication if conditions warrant. In the latter case, the medical staff member (a corpsman or physician) must go to the ship's communications station to carry on the conversation with a physician. He may then describe the patient's condition and symptoms. If additional information is needed, he may have to return to the treatment center to obtain the information (if the equipment and capability to obtain the required data are available), and then return to the communication center again. Past experience has shown that unless the diagnosis is clear, and this communication is for the purpose of requesting evacuation, this form of remote diagnosis is very unsatisfactory.

2.2 SHIPBOARD MEDICAL COMPLEMENTS. The scope of the RMDS has been limited to considering ships with a personnel complement of approximately 100 or more, and all submarines. Table 1 lists the major ship types by class, and gives the present number of active ships in each class (force level) and the average personnel complements assigned to ships of that class. In some cases, the personnel complements will be given in a range due to different classes of ships within that type. For example, destroyer tenders (AD's) are shown as having 800 to 1800 personnel aboard since destroyer tenders of the GOMPERS class have 1800 personnel aboard, while destroyer tenders of the KLONDIKE class have approximately only 800 personnel aboard. Information for Table 1 was compiled from "Jane's Fighting Ships 1972-1973."

A sampling of ships within each class (as given in Table 1) was used to determine a representative complement of medical personnel aboard ships of that class (see Table 2). Medical personnel assigned to each ship in the sampling (both enlisted and officers) was determined by information obtained through Enlisted Personnel Distribution Office Pacific Fleet (EPDOPAC), North Island, California.

2.3 SHIPBOARD MEDICAL EQUIPMENT. Medical equipment and instrumentation which are used for diagnosis and emergency treatment onboard ship were listed for ships by class. This information was obtained from documents of shipboard medical inventories - Authorized Medical Allowance Lists (AMAL) - for each class of ships, and then augmented by shipboard visits. It was found that many ships may actually have additional equipment to that required by the AMAL for a ship of its class. Thus, there are several inconsistencies for ships within each class. However, Table 3 lists the diagnostic equipment which is required by the AMAL and any additional equipment which is contained throughout that class of ships. It is not intended as a complete listing of

TABLE I FORCE LEVELS AND AVERAGE PERSONNEL COMPLEMENTS OF MAJOR SHIP CLASSES

	Force Level	Personnel Complements	
Aircraft Carriers			
CVAN	1	3100	(2400) *
CVA	13	2700	(2150) *
CVS	3	1600	(800) *
Cruisers			
CG	3	1000	
CGN	1	1000	
CLG	4	1680	
Auxiliary Ships			
AD	11	800 - 1800	
AR	7	700	
Underway Replenishment Ships			
AOE	4	600	
AOR	6	345	
AFS	7	430	
AE	17	300 - 400	
AO	24	300	
AF	4	350	
Amphibious Warfare Ships			
LPH	7	2090	
LCC	2	688	
LPD	14	490	(850) *
LPA	2	400	(1650) *
LSD	13	400	(350) *
LKA - Charleston Class	5	335	(225) *
LKA - Tulare Class	1	435	(320) *
LST	25	100 - 200	(390) *
Frigates			
DLGN	2	500	
DLG	28	400	
Destroyers			
DD	111	275 - 350	
DDG	29	350	
Escort Ships			
DE	65	220	
DEG	6	240	
Submarines			
SS	28	85	
SSN	58	100	
SSBN	41	112 - 140	
(*) Additional air-wing or troop complements			

TABLE 2
REPRESENTATIVE COMPLEMENT OF MEDICAL PERSONNEL ABOARD SHIP

	DISTRIBUTION OF MEDICAL ENLISTED PERSONNEL ABOARD SHIP																Approximate Total Number of Enlisted Medical Personnel Aboard Ship	Approximate Total Number of Physicians[1] Aboard Ship
	General Service	Nuclear Sub. Medicine Tech.	Sub. Medicine Tech.	Aerospace Medicine Tech.	Nuclear Medicine Tech.	Cardiopulmonary Tech.	Clinical Lab. Asst. Tech.	Clinical Lab. Tech.	Medical Services Tech. – not certified	Medical Services Tech. –certified	Preventive Medicine tech.	X-ray tech.	Optician Tech.	Physical & Occupational Therapy Tech.	Pharmacy Tech.	Operating Room Tech.		
Aircraft Carriers																		
CVAN	X			X	X			X	X		X	X	X	X	X	X	33	2
CVA/CVS	X			X				X	X		X	X			X	X	27	2
Cruisers																		
CG	X							X	X		X	X			X	X	10	1
CGN	X				X		X					X			X	X	10	1
CLG	X										X	X			X	X	8	1
Auxiliary Ships																		
AD	X				X[2]		X			X					X	X	12	1[3]
AR	X							X				X				X	10	1
Underway Replenishment Ships																		
AOE	X									X		X				X	6	1
AOR	X									X							4	1
AFS	X									X							4	1
AE – Suribachi Class	X									X							4	0
AE – Kilauea Class	X									X							4	0
AO, AF, AE – Wrangell Class	X									X							4	0
Amphibious Warfare Ships																		
LPH	X					X		X		X		X			X	X	10	1
LCC	X							X	X	X		X			X	X	12	1
LPD							X			X						X	3	1
LPA	X							X				X				X	11	1
LSD – Anchorage Class	X						X			X							5	0
LSD – Thomaston Class	X									X							4	0
LKA– Charleston Class	X						X			X		X				X	6	1
LKA – Tulare Class							X			X						X	5	1
LST	X									X							2	0
Frigates																		
DLGN	X				X					X							4	1
DLG	X									X							2	0
Destroyers																		
DD, DDG	X									X							2	1[4]
Escort Ships																		
DE, DEG	X									X							2	0
Submarines																		
Conventional			X														1	0
Nuclear		X															1	0[5]

1. Refers to a permanently assigned General Medical Officer except for CVAN and CVA/CVS which staff a Medical Flight Surgeon and either a Medical General Surgeon or a General Medical Officer. Additional physicians are provided by the assigned flight squadrons.
2. "Gompers" class only.
3. "Gompers" class has a Radiation Health Medical Officer in addition to the General Medical Officer.
4. One physician per squadron.
5. Some have a physician.

TABLE 3
MEDICAL EQUIPMENT *
BY CLASS OF SHIPS

* The list of medical material used in this table is not intended as a complete listing for all Naval Ships. The equipment was selected with respect to its importance as a diagnostic aid aboard ship.

	Drugs Biologicals & Offical Reagents																													Medical & Surgical Instruments, Equipment, & Supplies														X-ray Equip	Chemical Analysis Equipment			Laboratory Equipment & Supplies				Optical Instruments		
	Antigen, Lymphogranuloma Venereum	Antigen, VDRL	Basic Fuchsin, Analyzed Reagent	Blood Chemistry Referance & Control	Blood Detection Tablets	Blood Grouping Serum, Anti-A, Anti-B	Brain Heart Infusion	Canada Turpentine In Xylene	Crystal Violet, Analyzed Reagent	Diluent, Cardiolipin Antigen	Giemsa's Staining Solution	Ehrlich's Reagent	Methylene Blue, Analyzed Reagent	Nitroglycerin Tablets	Phenolsulfonphthalein Injection	Safranin O, Analyzed Reagent	Saponin, Analyzed Reagent	Sodium Citrate	Sodium Fluorescen Applicators	Sodium Phosphate, Monobasic, Monohydrate, Reagent	Sodium Sulfobromophthalein Injection	SS Agar	Sulfosalicylic Acid, Dihydrate, Analyzed Reagent	Tannic Acid, Analyzed Reagent	Test Kit, Bilirubin Determination (in urine)	Test Kit, Mononucleosis Determination	Test Strips, Urinary Blood, Glucose, Ketone, Protein, ph	Typing Serum, Anti-RH	Wright Blood Stain With Methyl Alcohol	Anoscope	Anesthesia Apparatus/Set	Audiometer	Cytoscope	Electrocardiograph	Light Slit, Ophthalmological	Magnifying Lens	Manometer, Spinal Fluid	Otoscope	Sigmoidoscope	Sphygmomanometer	Tube, Stomach, Aspirating	Urinometer	Visual Acuity	X-ray	Counter, Blood Cell, differential	Hemacytometer	Hemoglobinometer	Centrifuge, Lab.	Incubator, bacterial	Pipet, Red Corpuscle	Pipet, White Corpuscle	Spectrophotometer	Microscope, Binocular	Condenser, Dark field
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Aircraft Carriers																																																						
1 CVAN		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2 CVA/CVS/CVT		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Cruisers																																																						
3 CG	X	X	X		X	X	X	X	X	X	X		X	X		X		X	X			X	X	X	X	X		X	X	X	X			X		X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	X	
4 CGN	X	X	X		X	X	X	X	X		X		X	X		X		X	X			X	X	X		X		X	X	X	X			X		X	X	X		X	X		X	X		X	X	X	X	X	X		X	
5 CLG	X	X	X	X	X	X	X	X	X	X	X		X	X		X		X	X	X		X	X	X	X	X		X	X	X	X			X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	
Auxiliary Ships																																																						
6 AD	X	X	X	X	X	X	X	X	X	X	X		X	X		X		X	X	X		X	X	X	X	X		X	X	X	X			X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	
7 AR	X	X	X	X	X	X	X	X	X	X	X		X	X		X		X	X	X		X	X	X	X	X		X	X	X	X			X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	
Underway Replenishment Ships																																																						
8 AOE	X	X	X		X	X	X	X	X	X	X		X	X		X		X	X				X	X				X	X	X	X			X		X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	
9 AOR	X	X	X		X	X	X	X	X	X	X		X	X		X		X	X				X	X				X	X	X	X			X		X	X	X		X	X	X	X			X	X	X	X	X	X		X	
10 AFS			X		X	X	X	X	X		X		X	X		X		X	X				X	X				X	X	X	X			X		X	X	X		X	X	X	X	X		X	X	X	X	X	X		X	
11 AE - Suribachi Class	X	X	X		X	X	X	X	X	X	X		X	X		X		X	X				X	X				X	X	X	X			X		X	X	X		X	X	X	X			X	X	X	X	X	X		X	
12 AE - Kilauea Class	X	X	X		X	X	X	X	X	X	X		X	X		X		X	X				X	X				X	X	X	X			X		X	X	X		X	X	X	X	X		X	X	X	X	X	X		X	
13 AO, AF, AE, - Wrangell Class					X	X			X		X		X	X		X		X	X				X	X				X	X							X	X	X		X	X	X	X			X	X	X	X	X	X		X	
Amphibious Warfare Ships																																																						
14 LPH		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
15 LCC	X	X	X	X	X	X	X	X	X	X	X		X	X		X		X	X	X		X	X	X	X			X	X	X	X			X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
16 LPD	X	X	X	X	X	X	X	X	X	X	X		X	X		X		X	X			X	X	X	X			X	X	X	X			X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
17 LPA	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
18 LSD - Ancorage Class			X		X	X	X	X	X		X		X	X		X		X	X				X	X				X	X	X						X	X	X		X	X	X	X	X		X	X	X	X	X	X		X	
19 LSD - Thomaston Class			X		X	X	X	X	X		X		X	X		X		X	X				X	X				X	X	X						X	X	X		X	X	X	X			X	X	X	X	X	X		X	
20 LKA - Charleston Class			X		X	X	X	X	X		X		X	X		X		X	X				X	X				X	X	X	X			X		X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	
21 LKA - Tulare Class			X		X	X	X	X	X		X		X	X		X		X	X				X	X				X	X	X	X			X		X	X	X		X	X	X	X	X		X	X	X	X	X	X		X	
22 LST					X	X			X		X		X	X		X		X	X				X	X				X	X	X						X	X	X		X	X	X	X			X	X	X	X	X	X		X	
Frigates																																																						
23 DLGN	X	X	X		X	X	X	X	X		X		X	X		X		X	X				X	X				X	X	X	X			X		X	X	X		X	X	X	X	X		X	X	X	X	X	X		X	
24 DLG					X	X								X				X	X				X	X				X								X	X	X		X	X		X			X	X	X	X	X	X		X	
Destroyers																																																						
25 DD, DDG					X	X								X				X	X				X	X				X								X	X	X		X	X		X			X	X	X	X	X	X		X	
Escort Ships																																																						
26 DE, DEG					X	X								X				X	X				X	X				X								X	X	X		X	X		X			X	X	X	X	X	X		X	
Submarines																																																						
27 Conventional					X									X					X									X								X		X		X														
28 Nuclear					X									X					X									X								X		X		X														

medical diagnostic equipment for all U.S. Naval ships.

3. MEDICAL REQUIREMENTS

To determine the medical requirements for remote medical diagnosis, we have completed analyses to determine incidence rates of illnesses and injuries aboard ships and submarines, and determined the medical data and instrumentation which are needed to provide the information to diagnose these illnesses and injuries. Visits to shipboard and shore station medical facilities were made to generate listings of specific medical data and associated instrumentation. Discussions with medical personnel onboard also provided information on special medical needs derived from their experience.

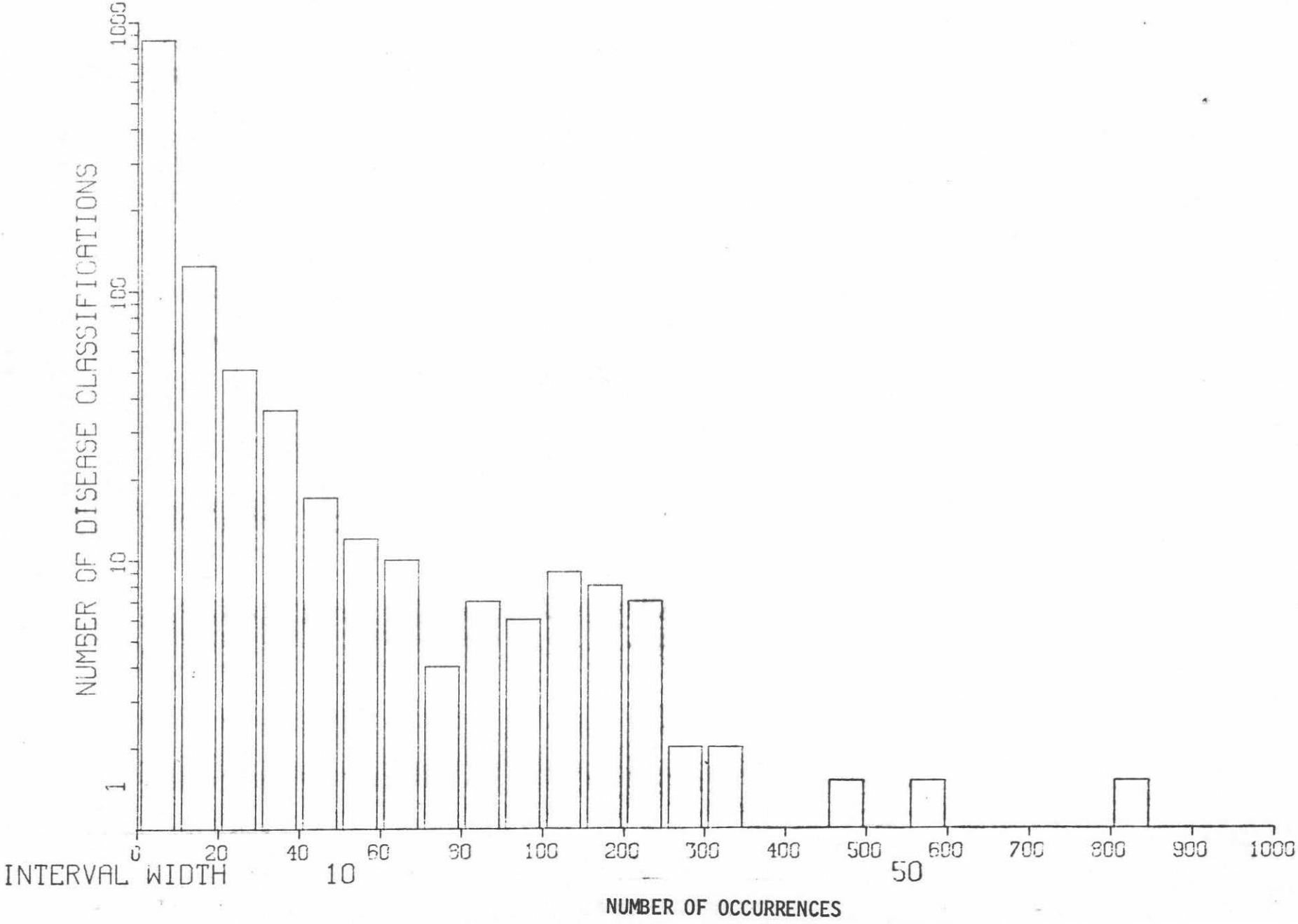
3.1 ILLNESS RATES. Data for all shipboard outpatient and inpatient visits by active duty Navy and Marine Corps personnel, for the period of July 1972 to May 1973, was obtained from Naval Medical Data Services Center (NMDSC), Bethesda, Maryland. This data was obtained for treatment diagnosis and by ship types. Onboard ships, an inpatient admission is defined as any patient visit which results in the patient being placed on the sick list and temporarily relieved from his present duties.

Inpatient admission data was received in a coded listing of diagnoses based on the "International Classification of Diseases, Adapted for Use in the United States," (ICDA), Public Health Service Publication No. 1693. Each ICDA code is considered as indicating a disease or injury classification, (denoted for simplicity as a disease classification).

Figure 1 shows the number of disease classifications for inpatient admissions as a function of the number of occurrences (on all ships) for that classification. For example, the first bar of the histogram shows that

FIGURE 1

INPATIENT VISITS



there were approximately 850 disease classifications having between one and ten occurrences, while the last bar shows that there was one disease classification having between 801 and 850 occurrences. Note that the interval widths for the number of occurrences are in groups of 10 for occurrences between one and 100, and groups of 50 for occurrences between 101 and 1000.

The outpatient data was not obtained in the same complete listing as the inpatient data, but rather was grouped into "selected conditions" by NMDSC as obtained from the Medical Service and Outpatient Morbidity Report NAVMED 6300/1. The outpatient data format is being changed to provide this data in a more extensive classification similar to that obtained for the inpatient admissions. However, it may be noted that the outpatient visits generally involve problems of lower severity in nature than the inpatient admissions.

The data has been rearranged into sixteen major categories similar to those of previous studies on illness patterns on various classes of ships (see references 1,2,3,4). Table 4 shows the annual rates of patient visits per 1,000 personnel for combined inpatient and outpatient data. Table 5 shows the percentage of total patient visits for each category of patient visits and class of ships. For example, on conventional carriers (with a total of 205,931 patient visits), general infections and parasitic disorders accounted for 1.4% of the visits, while genitourinary disorders accounted for 13.3% of the visits. Due to round-off errors, the percentages in each column may not add up to exactly 100%. Tables 6 and 7 show the corresponding percentages for patient visits for each illness category for inpatient and outpatient visits, respectively.

Comparing Tables 6 and 7 shows a very different distribution of illness categories for inpatient and outpatient data. For inpatient admissions

TABLE 4 ANNUAL RATES OF PATIENT VISITS BY SHIP TYPE; MAJOR CATEGORIES

	ALL SHIPS	CARRIERS		SUBMARINES		CRUISERS		DESTROYERS		AMPH VES	PATROL VESSELS	MINE VESSELS	AUX VES
		CON	NUC	CON	NUC	CON	NUC	CON	NUC				
PERSONNEL STRENGTH.....	225603	49600	4523	2590	13051	8416	1061	60773	999	33107	449	1694	49345
TOTAL PATIENT VISITS.....	4180.7	4151.8	4651.3	4456.0	3039.8	4176.4	3447.7	4116.4	4619.6	4041.0	4601.3	4708.4	4612.6
1. GEN. INFECTIOUS & PARASITIC..	59.4	59.8	45.5	61.0	24.3	79.7	36.3	63.2	55.1	81.2	80.2	49.7	47.6
2. RESPIRATORY CONDITIONS.....	1853.5	1653.8	1751.3	2650.6	1868.3	1610.4	1274.3	2085.5	2330.3	1803.4	2189.3	2510.0	1784.2
3. DERMATOLOGICAL.....	390.3	395.8	581.7	320.1	294.8	452.5	498.6	337.6	469.5	363.9	360.8	443.3	462.8
4. GENITOURINARY DISORDERS.....	386.5	553.7	757.7	130.1	61.5	397.2	552.3	276.2	461.5	447.3	227.2	242.6	378.3
5. GASTROINTESTINAL DISORDERS...	377.7	344.0	333.2	422.4	255.5	417.2	341.2	423.0	292.3	312.1	792.9	425.0	424.2
6. CRANIAL.....	2.7	2.3	2.2	3.1	2.8	2.9	3.8	2.8	2.0	2.7	0.0	1.8	2.9
7. OPHTHALMIC.....	0.9	1.2	1.5	0.0	0.5	1.1	0.0	0.8	1.0	0.6	0.0	0.6	0.9
8. EAR-NOSE.....	131.1	124.0	143.7	155.2	86.7	127.0	71.6	122.3	97.1	140.1	122.5	149.9	154.6
9. CARDIOVASCULAR.....	2.4	2.5	3.1	2.7	3.1	1.7	0.0	2.3	1.0	1.9	2.2	4.7	2.7
10. HEMTIC & LYMPHATIC.....	0.3	0.4	1.8	0.0	0.4	0.2	0.9	0.2	0.0	0.1	0.0	0.6	0.2
11. METABOLIC & ENDOCRINE.....	25.9	15.6	10.8	84.2	16.8	40.2	1.9	25.2	302.3	27.9	75.7	74.4	26.8
12. HEPTIC & BILIARY.....	1.4	1.7	2.0	1.2	1.1	1.4	0.9	1.1	1.0	1.1	0.0	1.8	1.9
13. MUSCULOSKELETAL.....	488.7	607.5	544.3	334.0	187.0	617.5	399.6	334.6	290.3	425.9	322.9	244.4	678.0
14. NEURAL.....	1.5	1.7	2.7	0.8	1.2	1.0	0.9	1.4	1.0	1.7	0.0	1.8	1.5
15. NEUROPSYCHIATRIC.....	104.7	79.2	137.7	66.4	60.5	66.7	71.6	86.5	145.1	107.7	64.6	99.2	163.3
16. PHYSICAL & CHEMICAL.....	353.8	308.8	332.1	224.3	175.5	359.9	193.2	353.4	170.2	323.4	363.0	467.5	477.7

TABLE 5 PERCENTAGES OF PATIENT VISITS BY SHIP TYPE; MAJOR CATEGORIES

	ALL SHIPS	CARRIERS		SUBMARINES		CRUISERS		DESTROYERS		AMPH VES	PATROL VESSELS	MINE VESSELS	AUX VES
		CON	NUC	CON	NUC	CON	NUC	CON	NUC				
TOTAL PATIENT VISITS.....	943207	205931	21038	11541	39672	35149	3658	250167	4615	133785	2066	7976	227609
1. GEN. INFECTIOUS & PARASITIC.	1.4	1.4	1.0	1.4	0.8	1.9	1.1	1.5	1.2	2.0	1.7	0.9	1.0
2. RESPIRATORY CONDITIONS.....	44.3	39.8	37.7	59.5	61.5	38.6	37.0	50.7	50.4	44.6	47.6	53.3	38.7
3. DERMATOLOGICAL.....	9.3	9.5	12.5	7.2	9.7	10.8	14.5	8.2	10.2	9.0	7.8	9.4	10.0
4. GENITOURINARY DISORDERS.....	9.2	13.3	16.3	2.9	2.0	9.5	16.0	6.7	10.0	11.1	4.9	5.2	8.2
5. GASTROINTESTINAL DISORDERS..	9.0	8.3	7.2	9.5	8.4	10.0	9.9	10.3	6.3	7.7	17.2	9.0	9.2
6. CRANIAL.....	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.1
7. OPHTHALMIC.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8. EAR-NOSE.....	3.1	3.0	3.1	3.5	2.9	3.0	2.1	3.0	2.1	3.5	2.7	3.2	3.4
9. CARDIOVASCULAR.....	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1
10. HEMTIC & LYMPHATIC.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11. METABOLIC & ENDOCRINE.....	0.6	0.4	0.2	1.9	0.6	1.0	0.1	0.6	6.5	0.7	1.6	1.6	0.6
12. HEPTIC & BILIARY.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13. MUSCULOSKELETAL.....	11.7	14.6	11.7	7.5	6.2	14.8	11.6	8.1	6.3	10.5	7.0	5.2	14.7
14. NEURAL.....	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15. NEUROPSYCHIATRIC.....	2.5	1.9	3.0	1.5	2.0	1.6	2.1	2.1	3.1	2.7	1.4	2.1	3.6
16. PHYSICAL & CHEMICAL.....	8.5	7.4	7.1	5.0	5.8	8.6	5.6	8.6	3.7	8.0	7.9	9.9	10.4

TABLE 6 PERCENTAGES OF INPATIENT VISITS BY SHIP TYPE; MAJOR CATEGORIES

	ALL SHIPS	CARRIERS		SUBMARINES		CRUISERS		DESTROYERS		AMPH VES	PATROL VESSELS	MINE VESSELS	AUX VES
		CON	NUC	CON	NUC	CON	NUC	CON	NUC				
TOTAL INPATIENT VISITS.....	18234	5023	888	181	902	553	86	4221	54	1967	44	165	4150
1. GEN. INFECTIOUS & PARASITIC.	5.1	7.4	8.4	5.0	4.3	5.1	9.3	3.2	3.7	3.9	2.3	2.4	4.1
2. RESPIRATORY CONDITIONS.....	10.2	9.4	34.6	6.1	8.8	12.8	22.1	8.8	3.7	9.2	6.8	6.7	8.2
3. DERMATOLOGICAL.....	14.3	15.9	11.7	17.7	13.0	15.6	24.4	13.8	14.8	12.1	22.7	15.8	14.1
4. GENITOURINARY DISORDERS.....	11.1	14.9	15.0	5.0	7.2	6.7	4.7	8.6	18.5	11.1	2.3	9.7	10.1
5. GASTROINTESTINAL DISORDERS..	12.6	12.5	11.8	17.1	14.2	11.8	9.3	12.8	14.8	12.3	2.3	13.3	12.5
6. CRANIAL.....	3.3	2.2	1.1	4.4	4.0	4.3	4.7	4.1	3.7	4.6	0.0	1.8	3.5
7. OPHTHALMIC.....	1.1	1.2	0.8	0.0	0.8	1.6	0.0	1.2	1.9	1.0	0.0	0.6	1.1
8. EAR-NOSE.....	2.2	1.7	1.4	3.9	2.5	3.6	3.5	2.3	0.0	2.4	2.3	1.2	2.6
9. CARDIOVASCULAR.....	3.0	2.5	1.6	3.9	4.5	2.5	0.0	3.3	1.9	3.2	2.3	4.8	3.2
10. HEMTIC & LYMPHATIC.....	0.3	0.4	0.9	0.0	0.6	0.4	1.2	0.3	0.0	0.1	0.0	0.6	0.2
11. METABOLIC & ENDOCRINE.....	0.9	0.7	0.2	1.1	1.2	1.8	1.2	1.1	1.9	0.8	0.0	0.0	1.0
12. HEPTIC & BILIARY.....	1.8	1.7	1.0	1.7	1.6	2.2	1.2	1.6	1.9	1.8	0.0	1.8	2.2
13. MUSCULOSKELETAL.....	16.0	13.5	5.7	23.8	23.2	13.9	4.7	18.5	18.5	15.4	25.0	20.6	17.1
14. NEURAL.....	1.9	1.7	1.4	1.1	1.8	1.4	1.2	2.0	1.9	2.9	0.0	1.8	1.8
15. NEUROPSYCHIATRIC.....	13.9	12.3	3.5	7.7	10.1	14.5	12.8	16.1	9.3	16.7	34.1	15.8	15.3
16. PHYSICAL & CHEMICAL.....	2.2	2.1	0.9	1.7	2.3	1.8	0.0	2.1	3.7	2.4	0.0	3.0	2.8

TABLE 7 PERCENTAGES OF OUTPATIENT VISITS BY SHIP TYPE; MAJOR CATEGORIES

	ALL SHIPS	CARRIERS		SUBMARINES		CRUISERS		DESTROYERS		AMPH VES	PATROL VESSELS	MINE VESSELS	AUX VES
		CON	NUC	CON	NUC	CON	NUC	CON	NUC				
TOTAL OUTPATIENT VISITS.....	924973	200903	20150	11360	38770	34596	3572	245946	4561	131818	2022	7811	223459
1. GEN. INFECTIOUS & PARASITIC.	1.3	1.3	0.7	1.3	0.7	1.9	0.9	1.5	1.2	2.0	1.7	0.8	1.0
2. RESPIRATORY CONDITIONS.....	45.0	40.6	37.8	60.3	62.7	39.0	37.3	51.4	51.0	45.2	48.5	54.3	39.2
3. DERMATOLOGICAL.....	9.2	9.4	12.5	7.0	9.6	10.8	14.2	8.1	10.1	9.0	7.5	9.3	10.0
4. GENITOURINARY DISORDERS.....	9.2	13.3	16.3	2.9	1.9	9.6	16.3	6.7	9.9	11.1	5.0	5.1	8.2
5. GASTROINTESTINAL DISORDERS..	9.0	8.2	7.0	9.4	8.3	10.0	9.9	10.2	6.2	7.7	17.6	8.9	9.1
6. CRANIAL.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7. OPHTHALMIC.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8. EAR-NOSE.....	3.2	3.0	3.2	3.5	2.9	3.0	2.0	3.0	2.1	3.5	2.7	3.2	3.4
9. CARDIOVASCULAR.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10. HEMTIC & LYMPHATIC.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11. METABOLIC & ENDOCRINE.....	0.6	0.4	0.2	1.9	0.5	0.9	0.0	0.6	6.6	0.7	1.7	1.6	0.6
12. HEPTIC & BILIARY.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13. MUSCULOSKELETAL.....	11.6	14.7	12.0	7.2	5.8	14.8	11.8	8.0	6.1	10.5	6.6	4.9	14.7
14. NEURAL.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15. NEUROPSYCHIATRIC.....	2.3	1.6	2.9	1.4	1.8	1.4	1.8	1.9	3.1	2.5	0.7	1.8	3.4
16. PHYSICAL & CHEMICAL.....	8.6	7.6	7.4	5.1	5.9	8.7	5.7	8.7	3.7	8.1	8.1	10.1	10.5

overall, musculo-skeletal has the highest percentage of occurrences with osteomyelitis, fractures, dislocations, and sprains being the major contributors. Dermatology is the second ranking category with infections of the skin and subcutaneous tissue, lacerations and contusions having the highest occurrences. The neuropsychiatric category had the third highest percentage of occurrences with personality disorders, alcoholism, and drug dependency or improper use being the major factors.

Venereal disease (VD) has been found to be a major health problem in the Navy, accounting for about 10% of all illnesses in first-term naval enlisted personnel (reference 5). The data obtained for the RMDS shows that overall, VD accounts for only 4.2% of all illnesses. This lower incidence rate may be due to several reasons. First the data being obtained is for all active duty Navy and Marine Corps personnel assigned to ships rather than just first-term naval enlisted personnel. Secondly, not all cases treated are reported. Finally, there have been more thorough programs of VD prevention in recent years.

Data for the inpatient admissions was also obtained based on ships located in either the Pacific or Atlantic Oceans. This data was analyzed to determine any significant differences for various classes of ships in the Pacific or Atlantic areas or for specific illness categories. A Chi-Squared test (with 11 degrees of freedom) at the 99% significance level shows, for all ships combined, disease categories 1,2,3,4,6,13, and 15 (see Table 4) to be significant. These same disease categories are also significant at the 99% level for both the Pacific and the Atlantic areas except for category 3 in the Pacific and category 6 in the Atlantic. The percentage deviation in the observed incidence rate from the expected incidence rate was then computed for the above disease categories. From this, one can see which class of ships varies in

either high or low incidence rate from the expected. For example, figure 2 shows the % deviation for the total inpatient admissions for the 12 ship classes used in Tables 4-7, where 1 denotes conventional carriers, 2 denotes nuclear carriers, etc. Figure 3, similarly, shows the % deviation for respiratory conditions (disease category 2).

These analyses have shown, for example, that nuclear crusiers (ship class 6) in the Pacific had substantially high incidence rates in total inpatient admissions, and in particular, in disease categories 1,2,3, and 6. Similarly, they showed that nuclear destroyers (ship class 8) in the Atlantic had substantially low incidence rates in total inpatient admissions, and in particular, in disease categories 1,2,4,6, and 15. (It should be noted that % deviation from the expected is bounded below by -100% but has no upper bound). The reason for nuclear carriers (ship class 2) in the Atlantic having very low % deviations is that the nuclear carrier was stationed in Atlantic waters for only a few months during the one year report period.

Data for outpatient visits separated into Pacific and Atlantic areas is also being obtained from NMDSC. Similar analyses will then be performed on this data to look for any significant differences.

3.2 MEDICAL DIAGNOSIS DATA AND INSTRUMENTATION. Using the incidence rates for illnesses as developed in section 3.1, medical data and associated instrumentation sufficient for diagnosis was determined for selected illnesses and injuries. Illnesses and injuries selected for consideration were those which had ten or more occurrences annually. Inpatient data only was used since an extensive breakdown of the outpatient data was not available. In addition to the above selected illness classifications, illnesses and injuries having a high "seriousness" were also considered.

Figure 2

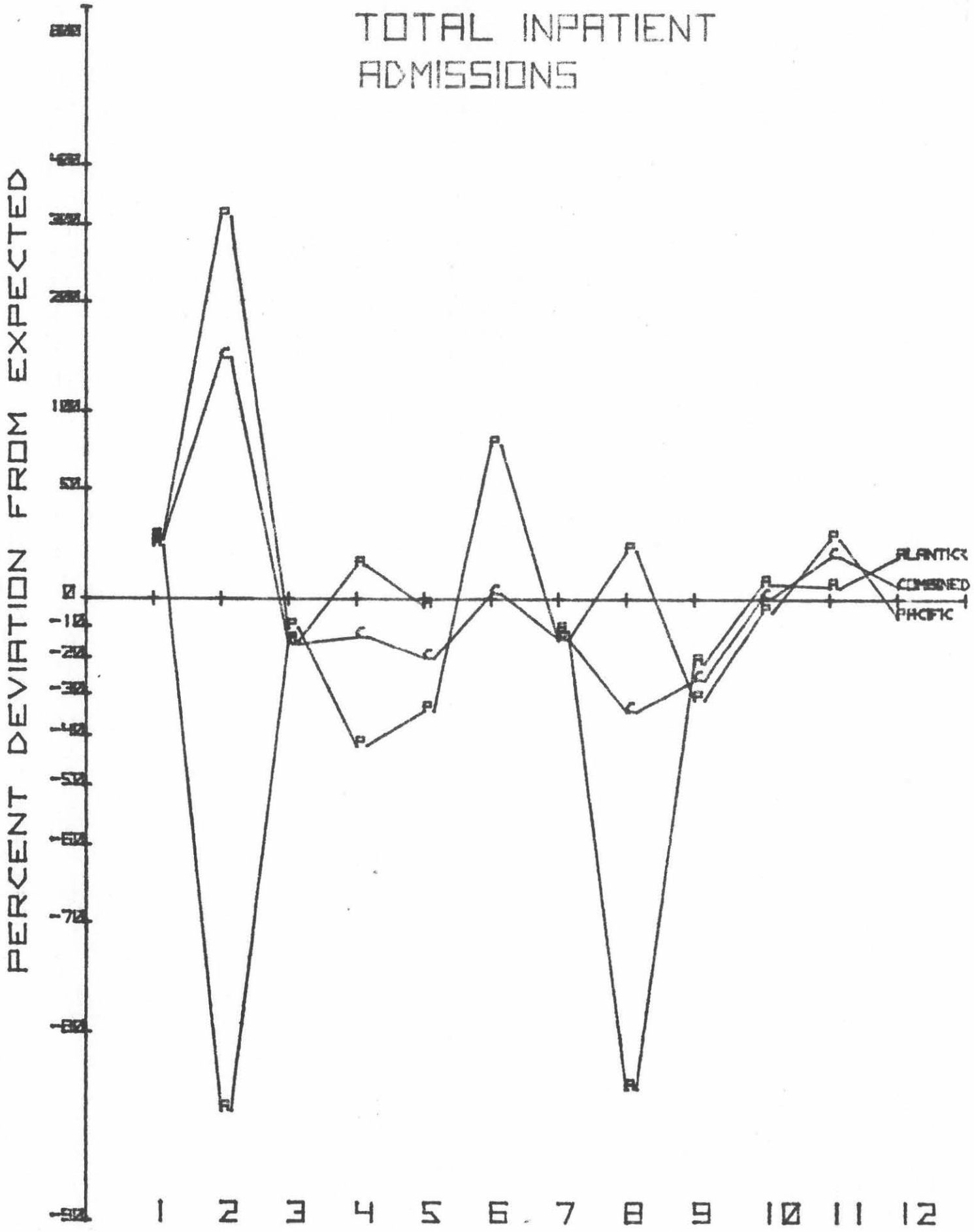
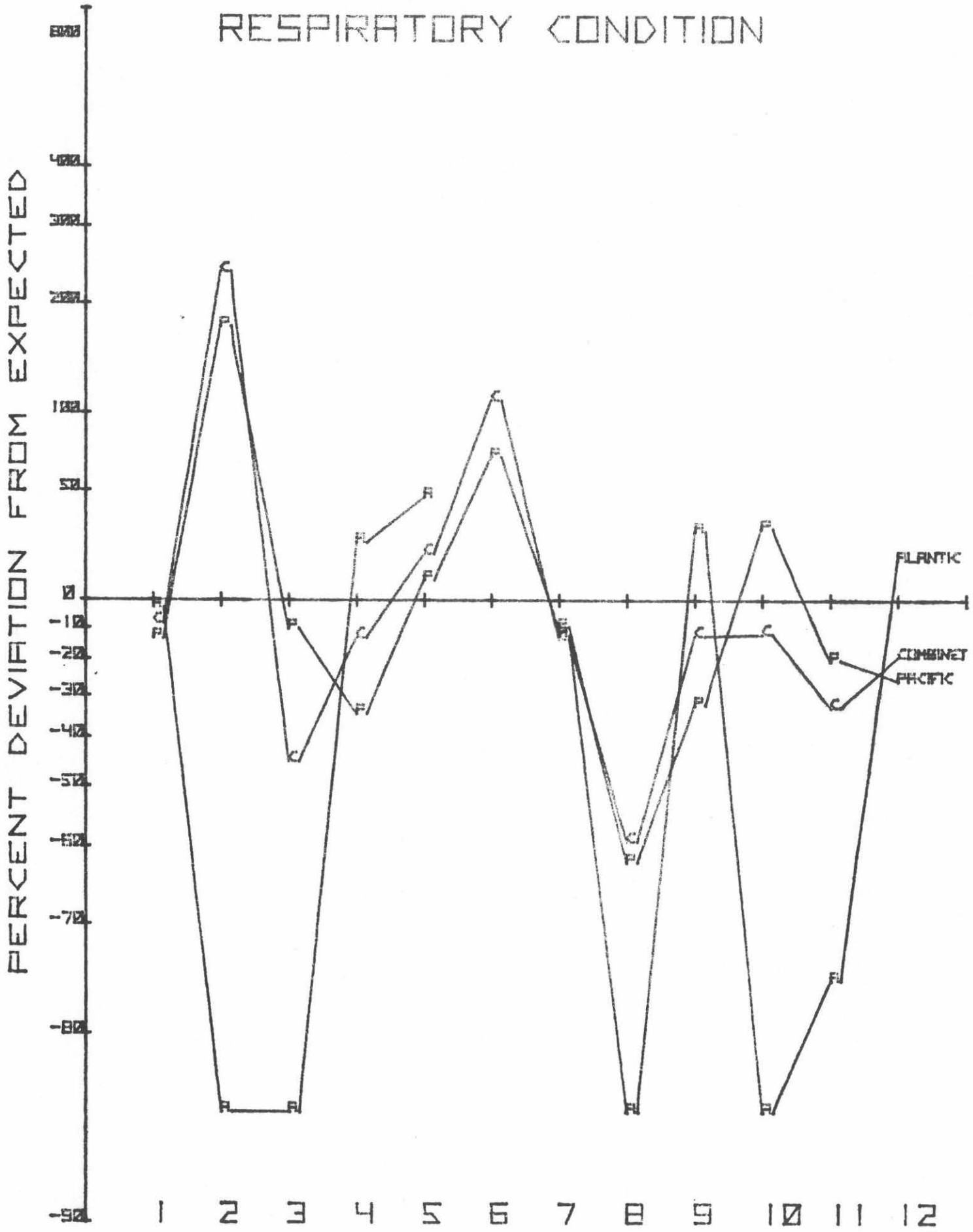

TOTAL INPATIENT
ADMISSIONS
PERCENT DEVIATION FROM EXPECTED
0
1 2 3 4 5 6 7 8 9 10 11 12

Figure 3


RESPIRATORY CONDITION
PERCENT DEVIATION FROM EXPECTED
ATLANTIC
COMBINED
PACIFIC
1
2
3
4
5
6
7
8
9
10
11
12

Medical data and instrumentation required or sufficient to diagnose these selected illnesses and injuries were determined using the "Merck Manual of Diagnosis and Therapy," "Clinical Diagnosis by Laboratory Methods" by Davidsohn and Henry, and by discussions with shipboard and shore station medical personnel. An example of this data is shown in Table 8 for infective and parasitic illness (a complete list is given in reference 8). "History" refers either to the patient's past medical history, or to a history of the patient's present illness symptoms.

The medical equipment used for the diagnosis of an illness is shown in two categories: first, the equipment that is listed on at least one class of ships (numbered entries corresponding to equipment listed in Table 3); second, the equipment which is not listed on the AMAL of any class of ships (lettered entries corresponding to equipment listed in Table 9). For example, diagnosis of German Measles uses equipments 11, 29, and 53, to be used conjunctively, and Y. Table 3 shows 11, 29, and 53 to be Giemsa's staining solution, Wright blood stain with methyl alcohol, and a binocular microscope, respectively. Table 3 also shows which classes of ships are listed as having this equipment. Table 9 lists Y as "viral antibody tests/or virus isolation," which is not listed in the AMAL of any class of ships.

4.0 REMOTE SYSTEM

4.1 PRESENT COMMUNICATIONS SYSTEM. The present Naval Telecommunications System (NTS) is essentially an HF/MF ship-to-ship and ship-to-shore radio network that evolved as long-range HF communication links were introduced into the fleet. This network is augmented by multifrequency broadcast links including VLF/LF components, as well as HF/MF. Ship-to-ship and ship-to-aircraft networks extensively use UHF for limited range communications.

TABLE 8 . SELECTED AILMENTS AND MEDICAL MATERIAL USED FOR DIAGNOSIS

	Examination and evaluation of clinical signs and symptoms	History	Numbered entries represent medical material that is listed on the AMAL of at least one class of ships (see table 3 for name and distribution of item)	Lettered entries represent medical material that is not listed on the AMAL of any class of ships (see table 9 for name of item)	Remarks
1. Infective and Parasitic					
German Measles	√*		(11,29,53)	Y	
Aseptic meningitis	√*			G,Y*	
Chickenpox	√		(11,53)	Y	
Mumps	√*		(11,29,53)	Y	
Measles	√	√	(11,29,53)		
Infectious mononucleosis	√		(8,11,29,53)*26*		
Viral infection (general)	√		(3,8,11,29,53,)44	Y*	
Sarcoidosis	√*		44	B*,E,M	
Influenza	√*		(8,11,29,53)		
Fever and chills	√		(3,8,9,11,13,29,53,)5,25,27,40,42,44,45,46,47,(7,49)56,57	B,N	
Lymphadenitis	√*		(8,11,29,53)		
Plague (pneumonic form)	√		(7,49)		
Diptheria	√		49	V	49 and V for use together

*Primary means of diagnosis.

Items within parenthesis indicate equipment that is to be used conjunctively.

TABLE 9 . MEDICAL MATERIAL NOT LISTED ON THE AMAL OF ANY SHIP BUT WITH IMPORTANCE AS A DIAGNOSTIC AID FOR SELECTED DISEASES

A	Retinoscope
B	Needle, Biopsy
C	Gastroscope
D	Endoscope
E	Spirometer
F	Tomograph
G	Lumbar Puncture Kit
H	Electroencephalograph
I	Catheter, Cardiac
J	Aspirating Tube, Bronchial
K	Wood Suction Biopsy Tube, Rubin Tube or Crosby Capsule
L	Test Kit, Serum Transaminase
M	Test Kit, Alkaline Phosphate
N	Test Kit, Pneumatoid Arthritis
O	Test Kit, Calcium Determination
P	C-Reactive Protein Test
Q	Thymol Turbidy or Cephalin Flocculation Test
R	Prothrombin Time Test
S	Serum Bilirubin Determination
T	Sera Antistreptolysin O Titer Determination
U	Phentolamine Mesylate
V	Loeffler's Medium
W	Vancomycin, Colistin, Nystatin and G.C. Medium Base
X	Barium Sulfate
Y	Viral Antibody Tests and/or Virus Isolation
Z	Meglumine Iothalamate, Meglumine Diatrizoate - Sodium Diatrizoate and Sodium Iothalamate Injections
AA	Gram Stain
BB	Topfer's Reagent
CC	Meglumine Iodipamide Injection

Each Navy ship is provided a basic capability to fill the communications needs associated with operations in which the unit may be expected to participate, and to support operational commands which may be expected to be embarked. The basic communications suite today uses HF and MF radio for over-the-horizon communications and VHF and UHF for line-of-sight communications.

The basic capability to communicate is fulfilled by several modes of transmission, which are:

a. C.W. (10-35 wpm)

b. Teletype (100 wpm, with a few 60 wpm)

c. Voice (3-4 kHz channels AM-SSB or FM)

d. Digital Data (1,364; 2,250; and 2,400 bps)

e. Facsimile (Various rates)

These modes will continue to be used in the Fleet for the next several years. Table 10 shows the general characteristics of the most common Naval communication systems.

Naval teletype messages are of two broad categories, Operational and Administrative. Messages relating to medical matters are considered Administrative. Teletype messages are sent according to four basic levels of precedence, which are:

. Flash

. Immediate

. Priority

. Routine

Administrative messages normally cannot be sent with a precedence higher than Priority. The fastest turnaround time for one exchange of messages is typically more than two hours.

Voice transmission is not dedicated for medical matters for ship-to-ship

TABLE 10. PRESENT NAVAL COMMUNICATIONS SYSTEMS (GENERAL CHARACTERISTICS OF MOST COMMON SYSTEMS)

MODE	DATA RATE	MAXIMUM BAND WIDTH	FREQUENCY BAND
TTY Single Channel	60 or 100 WPM	1.24 KHz	VLF/LF/MF/HF/UHF
TTY Multichannel	100 WPM	3.00 KHz	LF/MF/HF/UHF
CW	35 WPM	0.10 KHz	MF/HF/UHF
Digital Data	1,364/2,250/2,400bps	3.00 KHz	MF/HF/UHF
Voice	-	3-4 KHz	MF/HF/UHF/VHF
Facsimile	90 line/min	3.00 KHz	MF/HF/UHF

or ship-to-shore transmissions. However, communication networks which are a part of the U.S. Marine Corps landing force operations are specifically dedicated or shared for medical purposes. The use of voice circuits for medical matters is dependent on the doctrine of each ship when operating independently, or when in a task force within the rules specified in the task force Communications Plan (COMMPLAN).

The availability of digital data links for the transmission of medical information in the near future is questionable. Ship-to-ship data links presently in the fleet are dedicated to operational tactical data exchange. Sharing any of these data links would seriously degrade the service for which the NTDS links are now being used. Even if this concern was overlooked, extensive computer software reprogramming would be necessary to permit the mixing of tactical data with narrative medical data and new hardware would have to be developed to permit access to the data links for medical information exchange. After the FLTSATCOM is introduced into the fleet, and common user data terminals become widely installed on ships, then the digital data exchange of medical information will become practical.

Facsimile communication systems provide the capability of single channel reception and transmission of graphic and pictorial material. This mode of communication is primarily used for the transmission of environmental charts from shore to fleet units. Although many classes of ships are equipped to receive facsimile, the capability to transmit is provided only on the very largest ships. As presently configured, facsimile offers very little for medical personnel to employ for in-the-fleet information exchange.

4.2 MEDICAL COMMUNICATION REQUIREMENTS. Medical data is generated in several different forms which can be subdivided into the following data categories:

- alpha-numeric
- analog
- graphical
- photographic

The alpha-numeric data will primarily be narrative,plain language information, such as patient histories, laboratory test and medical reports. Analog data includes directly recorded physiological signals such as electrocardigram (ECG) and electroencephalogram (EEG) potentials; audio signals like speech and heart sounds; and video information such as a view of the patient or related graphical material. Graphical data includes information in the form of ECG, spirometry and blood pressure tracings, medical charts, printed material and line graphs. Photographic data will consist of x-ray negatives and pictures of the patient and/or injury sites, as well as printed material and graphical information.

The telecommunication of medical data via radio or land line can employ the following modes:

a. Teletype Circuits -

   1) Any data that can be reduced to alpha-numeric characters

b. Voice Circuits -

   1) Telemetered physiological potentials
   2) Physiological sounds
   3) Voice commentary
   4) Slow Scan television of x-rays and views of the patient
   5) Facsimile transmission of graphics, photographs, etc.

c. Digital Data Circuits -

   Any data that can be reduced to a digital format, such as:

   1) Alpha-numeric information
   2) Analog signals
   3) Graphics and photographs

d. Broad Band and Narrow Band Television Circuits -

1) X-ray negatives

2) View of the patient

4.3 SHIPBOARD REMOTE MEDICAL DIAGNOSTIC TERMINAL. A Remote Medical Diagnosis Terminal (RMDT) would enable a Navy hospital corpsman aboard ship to interface with the communications assets of a small ship in order to obtain external professional medical assistance in the diagnosis and treatment of injuries or disease. To determine the feasibility of providing this capability it was necessary to identify the communications requirements of the RMDT and then compare these requirements with available hardware, communication channels, and operational procedures.

A comprehensive survey (reference 8) of available hardware components and subsystems suitable for the design of an RMDT was performed. As a result it is apparent that recent technological advances have made possible low cost, low power data acquisition equipments. Such equipment, either procured as a subsystem entity or individually designed and built, provide the capability for monitoring multiple physiological waveforms and other input signals. For the present application, a simple system designed from existing components would appear to be the most cost effective approach. The forms of medical data most likely to be communicated during the next few years will be speech, narrow-band analog information, alpha-numeric information, graphics and photographs. For this type of data, most of the communication links presently available are adequate. Therefore, the RMDT will require components that will interface with the existing communication systems.

Most physiological waveforms contain highly redundant information

and can completely fill a normal narrow-band communications channel. Consequently, it may be necessary to include data reduction techniques in the data processing system. For example, a simple high fidelity ECG single-channel signal could provide a sufficient quantity of data output to completely fill a normal communications channel (300 samples per second x 8 bits per sample = 2400 bits per second - a common data rate). ECG waveforms can be compressed by a factor of ten and still contain most of the required clinical information. Similarly, there are other data compression schemes used for graphic or pictorial presentation. Such schemes are used currently by the Navy to transmit weather satellite photographs. These data compression techniques are relatively expensive to implement, although they could be quite inexpensive for use by RMDT if they were developed and available for other non-medical programs.

The present conceptual design for a RMDT is shown in the block diagram of figure 4 which identifies the interface components necessary to implement such a terminal. The frame storage memory is shared by the ship sensor inputs (e.g., radar, sonar, EW), the facsimile terminal, television camera, and the interactive CRT terminal. The data from the frame storage memory is compressed, synchronized, encrypted and interconnected with the communication channel with the appropriate modem hardware. Voice data is interfaced at the synchronizer. The slow scan digital video data is decompressed, converted to analog form for the television monitor. A digital tape recorder is used for video data storage and replay.

A detailed design for a shipboard RMDT is the end objective for the on going study. It is anticipated that most of the design requirements can be satisfied with off-the-shelf components. This aspect of the design is mandatory for rapid implementation in the field.

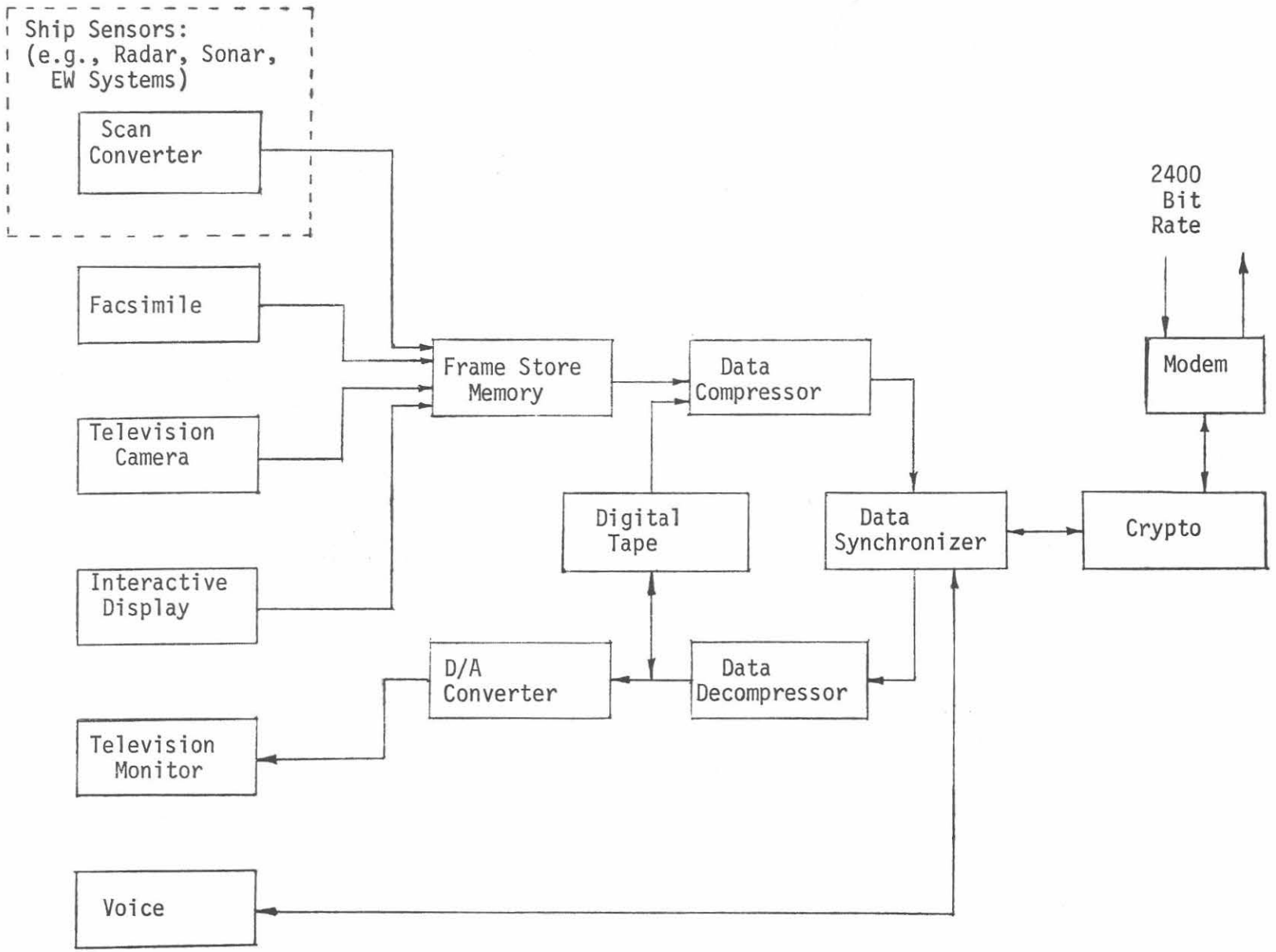


Figure 4. Shipboard Remote Medical Diagnosis Terminal. Conceptual Design

~~5. SUMMARY~~ BACKGROUND

A shortage of Navy physicians exists and will become more severe because the physician draft has terminated and many physicians are leaving military service. The health care of navy personnel aboard deployed vessels is obviously a vital responsibility. A study of injuries and ailments occurring aboard ships, however, indicates that the skills and training of a physician are seldom needed on many classes of smaller vessels and that except for medical contingencies, corpsmen provide adequate medical care.

A potential means of alleviating the physician shortage, therefore, is to use only corpsmen aboard most ships and provide for them the diagnosic skills of medical specialists located at remote sites when they are needed. If a patient requires treatment or surgery that the corpsmen cannot provide, he can be transported by helicopter to a larger vessel or shore based facility that is staffed with specialists. This is presently a common practice even with a physician on board and there are many good reasons to support this action.

Although ship-to-ship and ship-to-shore communications available for medical data transfer are narrow band channels, information in various forms including slow scan television can be effectively exchanged using little more than existing shipboard equipment. An experiment has been planned to test the practicality and effectiveness of remote medical diagnosis for Naval vessels. A prototype ~~RMDS~~ Remote Medical diagnosis System terminal will soon be installed aboard ship for several months initially using an HF communication link with a Navy hospital. Ultimately, the use of communication via satellite for remote diagnosis will also be evaluated.

The concept of remote diagnosis is not new, and its feasibility and effectiveness has already been demonstrated to varying degrees. Eskimo villagers in remote areas of Alaska have benefited from the services of Alaskan physicians located at hospitals and medical centers by using only a half-duplex voice communi-

cation link ~~(see reference 9).~~ In another case, the feasibility of transmitting ECG's from remote Alaskan villages to the University of Washington Hospital, Seattle, Washington, via HF radio and ATS-1 satellite was tested ~~(see references 10 and 11).~~ Consequently, the success of a remote medical diagnosis system for the Navy will depend primarily on reliable communications and sound operational doctrine.

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